SUSTAINABLE APPROACH TO SOLID WASTE

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ABSTRACT

Sustainable development is not a product but it is a process, one of the most obvious impacts of rapidly increasing urbanization and economic development can be witnessed in the form of heaps of solid waste. Solid-waste management has become an important issue in the Asia-Pacific region, and it needs to be resolved through an integrated community, private sector and policy based approach. An attempt has been made to establish that how these three factors –Sustainable development, Solid Waste management and Environment plays a significant role in the construction of agro- based nation and also look at the relationship how solid waste dumped in open space or landfill site can contribute to the generation of landfill gas and contribute to climate as well as environment conservation in developing countries.
This study endeavors to understand the role of solid waste for the development of individual, society and nation. It focuses on producing lasting impacts on the management of solid waste in developing countries.

Keywords: Solid waste Management, Environmental Conservation, Sustainable development, Landfill.

1. INTRODUCTION

Solid waste management is an important facet of sustainable development for any nation and prioritizing solid waste management is greatly supported by global initiatives. Solid waste generation is a continually growing problem at global, regional and local levels. Improper disposal of solid wastes pollutes all the vital components of the living environment (i.e., air, land and water) at local and global levels. Urban society rejects and generates solid material regularly due to rapid increase in production and consumption. The problem is more acute in developing nations than in developed nations, as their economic growth as well as urbanization is more rapid. This necessitates management of solid waste at generation, storage, collection, transfer and transport, processing, and disposal stages in an environmentally sound manner in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and environmental considerations. Thus, solid waste management includes all administrative, financial, legal, planning, and engineering functions (Ramachandra, 2006; Ramachandra and Varghese, 2003).

According to a United Nations Development Programme survey of 151 mayors of cities from around the world, the second most serious problem that city dwellers face (after unemployment) is insufficient solid waste disposal (UNDP 1997). Typically one- to two-thirds of the solid waste that is generated is.not collected. The uncollected waste is dumped indiscriminately in the streets and in drains, contributing to flooding, breeding of insect and rodent vectors, and spreading of diseases. Even waste that is collected is often disposed of in uncontrolled dumpsites or burned, polluting water resources and the air. Studies have shown that a high percentage of workers who handle refuse and of individuals who live near or on disposal sites are infected with gastrointestinal parasites, worms, and related organisms. Solid Waste Management (SWM) includes all activities that seek to minimize health, environmental, and aesthetic impacts of solid waste.

Given the current developments, the generation of solid waste in India in the year 2047 has been projected to exceed 260 million tons-a number more than five times the present levels. While the quantity of solid waste generated by society is increasing, the composition of solid waste is becoming more and more diversified. Thirty years ago, the composition of solid waste generated by the Indian farmer was characterised by one-fifth non-biodegradable waste and four-fifths biodegradable waste. At present, this ratio is about to reverse; today, a mere 40 percent is biodegradable while 60 percent is non-biodegradable. At the same time, many households do not

recycle their waste, but, instead, tend to dispose it outside their homes or on the streets.

The general principle of the *waste hierarchy* consists of the following steps, in order of environmental priority: (1) minimizing waste, (2) maximizing environmentally sound waste reuse and recycling, (3) promoting environmentally-sound waste disposal and treatment, and (4) extending waste service coverage.

However, although it is the duty of the Urban Local Bodies (ULBs) to address the issue of SWM, tight budgets, inefficient organisation, etc., has rendered a situation that has little hope for alleviation in the near future. Instead, garbage is burnt or dumped; either producing hazardous smoke or leeching into the soil and contaminating both soil and water.

1.1 The Solid Waste Management System

Solid waste can be defined as nonliquid material that no longer has any value to the person who is responsible for it. In urban areas, solid waste is generated by domestic households, commercial and industrial enterprises, and healthcare and institutional activities, as well as on the streets.

The term *solid waste* refers to solid waste from houses, streets and public places, shops, offices, and hospitals. Management of these types of waste is most often the responsibility of governmental authorities. A typical waste management system in a low- or middle-income country includes the following elements:

- Waste generation and storage.
- Segregation, reuse and recycling at the household level.
- Primary waste collection and transport to a transfer station or community bin.
- Street sweeping and cleaning of public places.
- Management of community bin.
- Secondary collection and transport to the waste disposal site.
- Waste disposal in landfills.
- Collection, transport, and treatment of recyclables at all points on the solid waste pathway (collection, storage, transport, and disposal).

In the past, these important elements of waste management were often regarded only from an engineering and technical viewpoint.

Physical handling of solid waste and recyclables is just one SWM activity; it alone cannot fulfill the requirement for sustainable and integrated solutions. Other activities are equally important:

- Making policy, as well as setting and enforcing standards and regulations.
- Evaluating data on waste generation and characterization for the purposes of planning and adapting system elements.
- Carrying out public information and awareness and education programs.
- Identifying and implementing financial mechanisms, economic instruments, and cost-recovery systems.
- Incorporating formal and informal elements of the private sector as well as community-based activities and non-governmental organizations (NGOs).

1.1.1 Service Coverage for Waste Collection

SW collection schemes of cities in the developing world generally serve only a limited part of the urban population. Lack of financial resources and planning capacity to cope with increasing urban population growth affects the availability or sustainability of a waste collection service. Operational inefficiencies, inappropriate technologies, or deficient management capacity of the institutions involved also give rise to inadequate service levels. With regard to the technical system, often the conventional collection approach-developed and used in industrial countries-is applied.

More and more, involving private companies in SWM is seen as an easy way out. However, an

important factor in the success of private sector participation is the ability of the client-usually a municipal administration-to write and enforce an effective contract. As an alternative to large (often international) companies that can provide most or all of the solid waste services in a city, microenterprises, small enterprises, or community-based organizations (CBOs) can provide services at the community level.

1.1.2 Recycling

Recycling of inorganic materials from SW is often well developed through the activities of the informal sector, although municipal authorities seldom recognize such activities. Some key factors that affect the potential for resource recovery are the cost of separating recyclable material and the separated material, its purity, its quantity, and its location. The costs of storage and transport are major factors that determine the economic potential for resource recovery.

1.1.3 Disposal

Most of the SW in developing countries is dumped on land in a more or less uncontrolled manner. Those dumps make very uneconomical use of the available space and often produce unpleasant and hazardous smoke from slow-burning fires. The present disposal situation is expected to deteriorate even more as with rapid urbanization, settlements and housing estates encircle existing dumps and the environmental degradation associated with the dumps directly affects the population. Waste disposal sites are, therefore, also subjected to growing opposition, and it is becoming increasingly difficult to find new sites that meet public approval and are located at a reasonable distance from the collection area. Landfills at very far distance from the central collection areas implies higher transportation costs, as well as an additional investments in road infrastructure, hence intensifying the financial problems of the responsible authorities

The safe alternative is a sanitary landfill, where solid wastes are disposed of at a carefully selected location that is constructed and maintained using engineering techniques such as liner's that minimize pollution of air, water and soil and other risks to people and animals.

1.1.4 Healthcare Waste and Hazardous Waste

Health care waste is generated as a result of activities related to the practice of medicine, sale of pharmaceuticals from hospitals and institutions is similar to domestic solid waste and may be called *general healthcare waste*. The remaining types of waste pose serious health hazards because of their physical, chemical, or biological nature. Such waste is known as *hazardous waste.*

Many strategies for treatment of hazardous waste rely solely on the use of incinerators or similar technologies. Such strategies have several weaknesses, because often the hospitals and healthcare facilities cannot afford to pay the operating costs of the treatment plant. The key to improving healthcare waste management is to provide better storage methods and to train the staff to adopt safer working practices and segregate hazardous waste from general healthcare waste. The management of hazardous chemicals is not only a technological and legislative issue but also a matter of enforcement, funding, and financial instruments. Changing to processes that use less hazardous substitutes and minimizing hazardous waste quantities that are discarded can be seen as the preferred options in dealing with any difficult waste. Composition of the waste provides a description of the constituents of the waste; this varies widely from place to place as is evident from Table 1.

Table 1: Relative composition of household waste in low, medium and high-income countries

Contents	Parameter	Low income countries	Medium income countries	High income countries
Physical and chemical properties	Organic %	40-85	20-65	20-30
	Paper %	1-10	15-30	15-40
	Plastics %	1-5	2-6	2-10
	Metal %	1-5	1-5	3-13
	Glass %	1-10	1-10	4-10
	Rubber, leather, etc. %	1-5	1-5	2-10

Source: INTOSAI working group on environmental auditing (2002).

1.2 Potential Environmental Impacts

The typical solid waste stream (SWS) will contain general wastes (organics and recyclables), special wastes (household hazardous, medical, and industrial waste), and construction and demolition debris. Most adverse environmental impacts of solid waste management are rooted in inadequate or incomplete collection, or in inappropriate siting, design, operation, or maintenance of landfills. Improper waste management activities can:

1.2.1 Increase Disease Transmission or Otherwise Threaten Public Health

Purefying organic materials pose great public health risks. They can become breeding grounds for disease vectors such as rats and flies. Waste-handlers and waste-pickers risk contracting and transmitting diseases, especially if human or animal excreta or medical waste is in the waste stream. Populations are also at an increased risk for poisoning, cancer, birth defects, and other ailments.

1.2.2 Contaminate Ground and Surface Water

Solid waste streams can bleed toxic materials and pathogenic organisms into the leachate of dumps and landfills. If the landfill is unlined, depending on the drainage system and the composition of the underlying soils, this runoff can contaminate ground or surface water. When leachate from sanitary landfills is discharged into surface water it will similarly contaminate these bodies. Many toxic materials can only be treated or removed with expensive advanced technologies.

1.2.3 Create Greenhouse Gas Emissions and other Air Pollutants

When organic wastes are disposed of in deep dumps or landfills they undergo anaerobic degradation and become significant sources of methane, which is inflammable & greenhouse gas. Garbage is often burned in residential areas and in landfills to reduce volume and uncover metals. Burning creates thick smoke that contains carbon monoxide, soot, and nitrogen oxide, all of which are hazardous to human health and degrade urban air quality. Combustion of polyvinyl chlorides (PVCs) generates highly carcinogenic dioxins.

1.2.4 Damage Ecosystems

When solid waste is dumped into rivers or streams it can alter the aquatic habitat and harm native plants and animals. High nutrient contents can deplete dissolved oxygen in the body of water, and solids can cause sedimentation and change the stream's flow and bottom habitat. Landfills in sensitive ecosystems may destroy or significantly damage these valuable natural resources and the services they provide.

1.2.5 Cause Flooding

The accumulation of waste along streets can clog drains and cause localized flooding. Even these accumulation can decrease the catchment area of any river.

1.2.6 Injure People and Property

In locations where shantytowns have been built near open dumps or badly designed or operated landfills, landslides can destroy homes and injure or kill residents.

Table 2: Health and Environmental Effects of Some Pollutants caused by burning of Solid waste

Pollutant	Health Effects	Environmental Effects
Carbon Monoxides	Cause dizziness, headaches and slowed reflexes.	Oxidized to carbon dioxide in the atmosphere.
Chlorofluorocarbons (CFCs)	Causes dizziness, headaches and slowed reflexes.	The primary contributor to stratospheric ozone level depletion and are involved in the global warming effect.
Heavy Metals (such as Mercury)	Highly toxic: heavy metals collect in the human system until a lethal dosage is reached. Non-lethal effects can include chronic respiratory or intestinal distress, poisoning of the central nervous system, disruption of effects of the body's hormone system, inhibition of growth and development of children.	Increase toxic loading on environment: leads to contaminated water/land, affects animal health.
Ozone (03)	Exposure to ozone can injuri biological tissues and cells. Reduce lung function, including tightness of the chest, coughing pain and breathing difficulty.	Ground –level ozone damages vegetation and ecosystem, effects animal health.
Nitrogen Oxides	Causes respiratory illness, fluid collection in the lungs and fibrotic changes.	Contribution to acid rain and ozone formation.
Particulate Matter (PM)	Irritation of respiratory tract, aggravated asthma, contributes to chronic obstructive pulmonary diseases.	Increased toxic loading on the environment: leads to contaminated water/ land and affects animal health.
Polynuclear Aromatic Hydrocarbon (PAH's)	Cancer causing agent in most animal species including mammals, fish & birds.	Increased toxic loading on environment: leads to contaminated water / land affects animals health.
Volatile Organic Compounds' (VOCs)	Directly toxic including problems ranging from cancer risks to nervous disorders. Causes respiratory irritation/illness, chronic lung disease.	Contributes to low level ozone (smog), causes vegetative damage, leads to contaminated water/land, affect animals health.
Sulphur Oxides (S02)	Increase in hear/lung disease, acute/ chronic respiratory diseases. Health people experience shortness of breath, sore throats, breathing difficulties.	Causes vegetative damage: corrodes many materials; contributes to acid rain (forests, aquatic and urban environments i.e structures).

1.3 Recommendations

1.3.1 Technical Aspects

The technical aspects for a sustainable SWM would have to take into account the following points for planning and implementation of strategies:

- Provision of facilities for primary collection of waste from curbside/community bins and adequate storage facilities in the urban areas based on the population density.
- Transportation of waste from the community storage facilities at regular intervals and improvement in the waste collection fleet.
- Transfer stations (at optimal distances from residential areas) should be constructed wherever necessary with provision for weighbridges.

- There must be a separate SWM system for hospitals, healthcare establishments and industries to prevent the infectious and hazardous wastes from entering the municipal waste stream.

1.3.2 Management Aspects

Sustainable SWM would call for the strengthening of the management sector which has to go hand in hand with technical planning. The effectiveness can only be achieved by a strong management that takes into consideration the following aspects:

- An executable master plan and implementation plans for SWM at the provincial level or the state level in accordance with the strategy for national environmental quality would help the management;
- Application of the 3R concepts, product stewardship, cleaner production and specification in the selection of packaging materials to the manufacturers.
- Continuous monitoring and record keeping of MSW aspects with the development of a systematic information system that can be comparable, utilizable and updated; and
- Providing of organizational support for encouraging the involvement of private sector operators, NGOs and CBOs.

1.3.3 Financial Aspects

- There should be provisions for subsidies (grant, soft loan, etc.) from government to local authorities, including the private sector, NGOs and CBOs;
- There should be transparency and coordination amongst the staff regarding the operation and maintenance costs at each level of waste handling so that the expenses are rational;
- Tax exemption for importing recycling technology and reduced tax benefits from those industries using waste and scraps as raw materials; and
- A fund or trust for promoting 3R needs to be developed instead of a micro credit program in the informal sector.

1.3.4 Legislative Aspects

Legislation and its effective enforcement is a key to sustainability for which the framework requires to be established. The related aspects are given hereunder:

- Set up of appropriate pollution discharge standards for solid waste disposal. facilities such as effluent and emission standards either based on World Health Organization norms or related to the national standards for pollution control;
- Develop regulations and related laws to set up mechanisms for implementing 3R concepts - Reduce, Reuse and Recycle;
- Declare a no-development buffer zone within 500 meters from the boundary of all processing and disposal sites; and
- The joint involvement of the Ministry of Finance, city planning offices and the Ministry of Environment to develop infrastructure plans on promotion of 3R is needed.

1.3.5 Supportive Aspects

Municipal bodies could have the required technology, financial resources, management structure and a framework of legislation for effective SWM. However, its implementation cannot be effectual unless the supportive aspects are mobilized to work hand-in-hand with the system. This can be achieved if the system can:

- Promote public education program, trainings and workshops, revise school curriculum by introducing the 3R concepts in general and SWM in particular, and reinforce social values for all children and citizens in the society; and
- Encourage waste separation and recycling program at sources-households, commercial centers, institutions and factories by employing segregation strategy that would fit the appropriate

waste collection and disposal practices.

The effective implementation of these strategies will help to solve the environmental pollution problems to a large extent.

2. SUMMARY

Waste generation, both domestic and industrial, continues to increase worldwide in tandem with growth in consumption. In developed countries, per capita waste generation increased nearly three-fold over the last two decades, reaching a level five to six times higher than that in developing countries. With increases in populations and living standards, waste generation in developing countries is also increasing rapidly, and may double in volume in the current decade. If current trends continue! the world may see a five-fold increase in waste generation by the year 2025. A high proportion of the waste could be recycled by the urban poor generating income for themselves and protecting the environment. There is a need to develop an integrated approach where the public, private and community sectors work together to develop local solutions promoting sustainable solid waste management.

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